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SIANGCHIN, KEVIN	
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8

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/751,147	Applicant(s) SCHOEPFLIN ET AL.
	Examiner Kevin Siangchin	Art Unit 2623

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE ~~2~~ 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☐ Claim(s) *1-7,9-15 and 18-26* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-7,9-15 and 18-25* is/are rejected.

7)☒ Claim(s) *26* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

Detailed Action

Drawings

Response to Amendments to the Drawings

1. The corrected and/or new drawings were received on March 8, 2004. These drawings are approved.

Specification

Response to Amendments to the Specification

2. The amendments to the specification filed on March 8, 2004 have been acknowledged. These amendments adequately address the deficiencies of the original specification. Therefore, the previous objections to the specification are withdrawn.

Claims

Response to Amendments to the Claims

3. The amendment to the claims filed March 8, 2004 has been entered into the record and claims 1, 13, and 18-19 have been amended accordingly. Claims 8 and 16-17 have been cancelled. Claims 24-26 have been added.

Response to Arguments and Remarks

4. ***The following is in regard to the Applicant's assertion that Claim 1, as amended, distinguishes over prior art.*** Applicant's arguments filed on March 8, 2004 have been fully considered but are not persuasive for at least the following reasons. Note that reference will be made to the previous Office Action, particularly to the sections

relating to original Claim 1 and cancelled Claim 8. Please refer to paragraphs 1-7 and 23-25 of the previous Office Action.

5. The Applicant amended claim 1 in such a way as to incorporate the limitations of cancelled claim 8 into the original claim 1. Due to the dependence of cancelled claim 8 on original claim 1, arguments set forth in the previous Office Action in regard to the 35 U.S.C. § 103(a) rejections of claims 1and 8 are, collectively, applicable to the amended claim 1. In particular, it was adequately shown in the previous Office Action that the combined teachings of Dickie (U.S. Patent 5,999,651), Geiger ("Dynamic Programming for Detecting, Tracking, and Matching Deformable Contours") and Sethian ("Level Set Methods and Fast Marching Methods") address the following aspects of amended claim 1:

(1.a.) Receiving a set of control points used in deriving an object boundary from a prior image frame, wherein the received set of control points serves as an initial set of control points for the current digital image frame.

(1.b.) Defining a restricted area within the current digital image frame based on the received set of control points, wherein the restricted area corresponds to a band about the object boundary.

(1.c.) Updating the initial set of control points to an updated set of control points in response to an operator command.

(1.d.) Deriving a current-frame object boundary as a closed contour connecting each control point of the updated set of control points, wherein only image data within the restricted area are eligible to form the closed contour, wherein said derived closed contour serves as a current frame object boundary.

Furthermore, it was shown in the previous Office Action that the teachings of Sun et al. (U.S. Patent 6,546,117) can be combined with those of Dickie, Geiger and Sethian to satisfy the limitations of cancelled claim 8, which correspond to the following aspects of amended claim 1:

Deriving a current-frame object boundary as a closed contour connecting each control point of the updated set of control points, such that, for each one control point of the updated set of control points, a path is derived from said one control point to an adjacent control point by:

(1.e.) Determining a distance from said one control point to said adjacent control point.

(1.f.) When said distance is less than a threshold distance applying a first set of rules for deriving the path from said one control point to the adjacent control point.

(1.g.) When said distance is greater than the threshold distance applying a second set of rules, different from the first set of rules, for deriving the path from said one control point to the adjacent control point, wherein said derived closed contour serves as a current frame object boundary.

For the sake of brevity, the details of the arguments that were presented in the previous Office Action relating to these aspects of amended claim 1 are omitted. Please refer to paragraphs 1-7 and 23-25 of the previous Office Action.

The Teachings of Sun et al. (U.S. Patent 6,546,117).

6. The Applicant correctly summarizes the pertinent teachings of Sun et al. in paragraph 1on page 15 of the amendment.

7. The Applicant argues that "the [Examiner's] characterization of Sun et al. does not involve the same steps as required by amended claim 1, nor does it suggest such steps". It will be assumed here that the Applicant is specifically referring to steps (1.e)-(1.g) above, since the teachings of Sun et al. were applied to similar limitations in the previous Office Action. Specifically, the Applicant asserts that according to method of Sun et al., "once the control points are obtained, however, there is no additional step of using a first set of rules or a second set of rules to derive a path to connect the two control points for which a distance was determined". On the contrary, the method of Sun et al. executes a first set of rules (i.e. eliminating the adjacent control points from the set of control points) when the measured distance between these control points is less than a first threshold, and executes a second set of rules (i.e. adding additional control points by interpolating the two adjacent control points) when the distance is greater than a second threshold (that threshold being greater than the first threshold). The word *rule* is interpreted

here as meaning a predetermined sequence of steps for the purposes of obtaining a certain result. In this manner, eliminating the adjacent control points from the set of control points, indeed, represents a rule – e.g. a *first* rule. Similarly, adding additional control points by interpolating the two adjacent control points represents a rule – e.g. a *second* rule.

8. The applicant further asserts that, in the method of Sun et al., "the two control points used for determining distance are different than the control points for which a path is derived". While this is true in some cases, it does not mean Sun et al. fail to teach the aforementioned steps (1.e)-(1.g). In light of the preceding discussion, one realizes that this assertion is true only when the distance between the adjacent control points is less than the first threshold. However, the assertion is not valid for instances where the distance between the adjacent control points is greater than the second threshold.

9. To illustrate this consider a subset of the set of control points, say, $S = \{p_{i-1}, p_i, p_{i+1}, p_{i+2}\}$, where p_i and p_{i+1} are the adjacent control points under consideration. Assume the first threshold is τ_1 and second threshold is τ_2. If the distance $d_{i,i+1}$ between these adjacent control points is $d_{i,i+1} < \tau_1$ then, according the method of Sun et al., the points p_i and p_{i+1} are eliminated. As a result, p_{i-1} and p_{i+2} become adjacent and consequently the control points for which the path is derived. In this case, the control points (i.e. p_i and p_{i+1}) used for determining distance are different than the control points (i.e. p_{i-1} and p_{i+2}) for which a path is derived. If, on the other hand, the distance between these adjacent control points is $d_{i,i+1} > \tau_2$ then, according the method of Sun et al., the points p_i and p_{i+1} are interpolated, thereby generating, say, control points $q_1, q_2, \ldots, q_M$ between p_i and p_{i+1}. The set S then becomes $S = \{p_{i-1}, p_i, q_1, q_2, \ldots, q_M, p_{i+1}, p_{i+2}\}$. An optimal contour is subsequently derived that spans p_i and p_{i+1} (step 202, Sun et al. Fig. 11). Therefore, in instances where $d_{i,i+1} > \tau_2$, the control points (i.e. p_i and p_{i+1}) used for determining distance are the same as the control points (i.e. p_i and p_{i+1}) for which a path is derived.

10. Despite the validity, under certain circumstances, of the Applicant's assertion that, in the method of Sun et al., "the two control points used for determining distance are different than the control points for which a path is derived", Sun et al. still teach the steps (1.e)-(1.g) above. First, when given its broadest interpretation a "set of rules for deriving a path from said one control point to the adjacent control point" can, indeed, include rules that result in

not deriving a path from said one control point to the adjacent control point. As a simplified analogy, consider rules for building a house. Rules for building a house may include rules for not building that house in certain circumstances (e.g. when building a house, do not build a house on unstable ground or when building a house, do not build the house if it costs too much). Seen in this light, the rule for eliminating the adjacent control points from the set of control points when the distance spanning the adjacent control points is less than the first predetermined threshold distance can still be considered a rule for deriving a path between the said one control point to the adjacent control point, despite the fact that, in this case, a path is not derived between the control points. In a manner similar to the analogy above, the first set of rule does not derive a path between the said one control point and the adjacent control point because it has been determined that circumstances (i.e. the distance between these points is less than the first threshold) do not warrant having a path between these points. In this way, the arguments presented in previous Office Action regarding canceled claim 8 adequately address the corresponding subject matter of claim 1 and the arguments raised by the Applicant relating to the deficiencies of Sun et al.'s teachings.

11. Defining the first set of rules for deriving the first set of rules in this manner is, admittedly, rather circuitous .The concerns raised by the Applicant in regard to this definition are understandable. However, by redefining Sun et al.'s first set of rules for deriving a path between the said one control point and the adjacent control point, it can be shown, more explicitly, that Sun et al. teaches the steps (1.e)-(1.g) in such a way that the two control points used for determining distance are *the same as* the control points for which a path is derived. This is explained below.

12. As mentioned previously, in the method of Sun et al., the distance between adjacent control points is compared to a second threshold (hereinafter, τ_2. The aforementioned first threshold will be denoted τ_1). In the case that the distance is greater than the second threshold, the method of Sun et al. derives a path between the said adjacent control points using a second set of rules. If, on the other hand, the distance is less that the second threshold (τ_2), the method of Sun et al. derives a path between the said adjacent control points using a first set of rules. The second set of rules is the same as that which was described above and in the previous Office Action. The first set of rules is redefined here to be the set of actions performed in the method of Sun et al. when the distance is less than the second threshold (τ_2) – that is, derive the optimal contour as usual (i.e. steps 200-202 in Sun et al. Fig. 11), for distance d such that $\tau_1 < \delta < \tau_2$, or eliminate points when $d < \tau_1$. See Sun et al. Fig. 11 and column 17, lines 65-67 to

column 18, lines 1-12. Therefore, Sun et al. teach: (1.e) Determining a distance, *d*, from said one control point to said adjacent control point, (1.f) when said distance is less than a threshold distance, τ_2, applying a first set of rules for deriving the path from said one control point to the adjacent control point (i.e. derive the optimal contour as usual [i.e. steps 200-202 in Sun et al. Fig. 11], for distance *d* such that $\tau_1 < \delta < \tau_2$, or eliminate points when $d < \tau_1$. [Sun et al. Fig. 11 and column 17, lines 65-67 to column 18, lines 1-12]), and (1.g) when said distance is greater than the threshold distance applying a second set of rules, different from the first set of rules, for deriving the path from said one control point to the adjacent control point (i.e. adding additional control points by interpolating the two adjacent control points and deriving the contour, the original second set of rules), wherein said derived closed contour serves as a current frame object boundary. These observations and the discussion in the previous Office Action relating to original claim 1 serve as the basis for the 35 U.S.C. § 103(a) rejection of amended claim 1 below.

Rejections Under 35 U.S.C. § 103(a)

13. Reference will be made to the previous Office Action, which is incorporated herein in its entirety. See also the discussion above in response to the Applicant's arguments.

14. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action.

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

15. Claims 1-7, 9-10, 12-15, 18-19, and 22-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dickie (U.S. Patent 5,999,651), in view Geiger et al. ("Dynamic Programming for Detecting, Tracking, and Matching Deformable Contours"), Sethian ("Level Set Methods and Fast Marching Methods"), and Sun et al. (U.S. Patent 6,546,117).

16. *The following is in regard to Claim 1.* As shown above and in the previous Office Action, Dickie (U.S. Patent 5,999,651), Geiger ("Dynamic Programming for Detecting, Tracking, and Matching Deformable Contours") and Sethian ("Level Set Methods and Fast Marching Methods") can be combined so as to address the following aspects of amended claim 1:

A method for segmenting an object within a current digital image frame, comprising the steps of:

(1.a.) Receiving a set of control points used in deriving an object boundary from a prior image frame, wherein the received set of control points serves as an initial set of control points for the current digital image frame.

(1.b.) Defining a restricted area within the current digital image frame based on the received set of control points, wherein the restricted area corresponds to a band about the object boundary.

(1.c.) Updating the initial set of control points to an updated set of control points in response to an operator command.

(1.d.) Deriving a current-frame object boundary as a closed contour connecting each control point of the updated set of control points, wherein only image data within the restricted area are eligible to form the closed contour, wherein said derived closed contour serves as a current frame object boundary.

17. For the sake of brevity, the details presented in the previous Office Action relating to steps (1.a)-(1.d) will be omitted here. Please refer to the appropriate sections of the previous Office Action.

18. Dickie, Geiger, and Sethian do not, however, show the following steps:

Deriving a current-frame object boundary as a closed contour connecting each control point of the updated set of control points, such that, for each one control point of the updated set of control points, a path is derived from said one control point to an adjacent control point by:

(1.e.) Determining a distance from said one control point to said adjacent control point.

(1.f.) When said distance is less than a threshold distance applying a first set of rules for deriving the path from said one control point to the adjacent control point.

(1.g.) When said distance is greater than the threshold distance applying a second set of rules, different from the first set of rules, for deriving the path from said one control point to the adjacent control point, wherein said derived closed contour serves as a current frame object boundary.

19. As discussed extensively above, Sun et al. teach the following:

Deriving a current-frame object boundary as a closed contour connecting each control point of the updated set of control points, such that, for each one control point of the updated set of control points, a path is derived from said one control point to an adjacent control point by:

(1.e.) Determining a distance from said one control point to said adjacent control point.

(1.f.) When said distance is less than a threshold distance applying a first set of rules for deriving the path from said one control point to the adjacent control point.

(1.g.) When said distance is greater than the threshold distance applying a second set of rules, different from the first set of rules, for deriving the path from said one control point to the adjacent control point, wherein said derived closed contour serves as a current frame object boundary.

For the sake of brevity, the details will not be repeated here.

20. It was adequately shown in the previous Office Action that teachings Dickie, Geiger, Sethian, and Sun et al. were combinable. The motivation for combining Dickie, Geiger, and Sethian were provided in the previous Office Action and remains applicable to those aspects of amended claim 1 common to original claim 1. See the appropriate sections of the previous Office Action. The motivation for incorporating the teachings of Sun et al. into the combined teachings of Dickie, Geiger, and Sethian is similar to that which was given in the previous Office Action. The advantage of incorporating steps (1.e)-(1.g) into the segmentation method, obtained by combining the teachings of Dickie, Geiger, and Sethian, in the manner described above and in the previous Office Action, is that it provides an "adaptive" refinement of the contour. When control points are too distant ($d > \tau_2$), points are added (i.e. the contour is refined), thereby making the contour more responsive to the local features of the object boundary. Taking this into account, it would have been obvious to one of ordinary skill in the art, at the time of the applicant's claimed

invention, to incorporate the teachings of Sun et al., as described above and in the previous Office Action, into the segmentation method, obtained by combination of Dickie, Geiger, and Sethian. The segmentation method thus obtained conforms to the method set forth in claim 1.

21. *The following is in regard to Claim 2.* As shown above, the teachings of Dickie, Geiger, Sethian, and Sun et al. can be combined so as to satisfy the limitations of claim 1. As shown in the previous Office Action, Dickie teaches the step of updating comprises updating the initial set of control points to an updated set of control points in response to an operator command to perform either one of moving a control point or adding a control point. For the sake of brevity, the details presented in the previous Office Action relating to this step will be omitted here. Please refer to the section of the previous Office Action relating to original claim 2. Therefore, the teachings of Dickie, Geiger, Sethian, and Sun et al. can be combined to yield a segmentation method in accordance with claim 2

22. *The following is in regard to Claim 3.* As shown above, the teachings of Dickie, Geiger, Sethian, and Sun et al. can be combined in such a way as to satisfy the limitations of claim 2. As shown in the previous Office Action, Sethian teaches the step of redefining the restricted area to encompass the select control point, when the operator command either one of moves or adds a select control point outside the restricted area. For the sake of brevity, the details presented in the previous Office Action relating to this step will be omitted here. Please refer to the section of the previous Office Action relating to original claim 3. The teachings of Dickie, Geiger, Sethian, and Sun et al. can thus be combined to yield a segmentation method in accordance with claim 3.

23. *The following is in regard to Claim 4.* As shown above, the teachings of Dickie, Geiger, Sethian, and Sun et al. can be combined in such a way as to satisfy the limitations of claim 1. As shown in the previous Office Action, Dickie teaches the steps of:

(4.a.) Deriving edge energy data for the current image frame.

(4.b.) Deriving and displaying an initial estimate of the current-frame object boundary based on the received set of control points and the derived edge energy data.

For the sake of brevity, the details presented in the previous Office Action relating to these steps will be omitted here. See sections of the previous Office Action related to original claim 4. Note these steps are illustrated in Dickie Fig. 5. From Dickie Fig. 3, it is clear that these steps (encompassed in Dickie Fig. 3 step 40) precede the step of

updating (e.g. steps 42-44 in Dickie Fig, 3). Thus, Dickie addresses the limitations of claim 4. Therefore, the teachings of Dickie, Geiger, Sethian, and Sun et al. can be combined to yield a segmentation method in accordance with claim 4.

24. *The following is in regard to Claim 5.* As shown above, the teachings of Dickie, Geiger, Sethian, and Sun et al. can be combined so as to satisfy the limitations of claim 4. As shown in the previous Office Action, Dickie teaches that the current digital image frame is displayed and the initial estimate of the current-frame object boundary is overlaid onto the current digital image frame with the initial set of control points frame, wherein the step of updating the initial set of control points comprises selecting a control point of the initial set of control points with a pointing device and dragging the selected control point to a new location. For the sake of brevity, the details presented in the previous Office Action relating to this matter will be omitted here. See the sections of the previous Office Action related to original claim 5. The teachings of Dickie, Geiger, Sethian, and Sun et al. can thus be combined to yield a segmentation method in accordance with claim 5.

25. *The following is in regard to Claim 6.* . As shown above, the teachings of Dickie, Geiger, Sethian, and Sun et al. can be combined in such a way as to satisfy the limitations of claim 5. As shown in the previous Office Action, the steps of :

(6.a.) Testing the new location of the selected control point to determine whether the selected control point is outside the restricted area.

(6.b.) When the new location of the selected control point is outside the restricted area, redefining the restricted area to encompass the selected control point in the new location.

follow from Sethian's teachings relating to the re-initialization of the Narrow Band Level Set Method. For the sake of brevity, the details presented in the previous Office Action relating to these steps will be omitted here. See the sections of the previous Office Action related to original claim 6.

26. *The following is in regard to Claim 7.* As shown above, the teachings of Dickie, Geiger, Sethian, and Sun et al. can be combined so as to satisfy the limitations of claim 5. As shown in the previous Office Action, Dickie teaches that the step of defining the current-frame object boundary comprises deriving a path from the selected control point to a first adjacent control point and deriving a path from the selected control point to a second adjacent

control point. . For the sake of brevity, the details presented in the previous Office Action relating to this step will be omitted here. See the sections of the previous Office Action related to original claim 7. Therefore, the teachings of Dickie, Geiger, Sethian, and Sun et al. can be combined to yield a segmentation method in accordance with claim 7.

27. *The following is in regard to Claim 9.* As shown above, the teachings of Dickie, Geiger, Sethian, and Sun et al. can be combined in such a way as to satisfy the limitations of claim 1. Note that, despite the change in its claim dependency, amended claim 9 proposes essentially the same subject matter as claimed in original claim 9. It was shown in the previous office action that the second set of rules for connecting control points, when evaluated within the context of the segmentation method derived from the combined teachings of Dickie, Geiger, Sethian, and Sun et al., is less accurate than first set of rules (in terms of the derived path), in the cases when the distance between the adjacent control points is sufficiently small (e.g. when $d < \tau_1$). The analysis presented there is still applicable to the present discussion, despite the difference in the definition of the first set of rules. Therefore, the teachings of Dickie, Geiger, Sethian, and Sun et al. can be combined to yield a segmentation method in accordance with claim 9.

28. *The following is in regard to Claim 10.* As shown above, the teachings of Dickie, Geiger, Sethian, and Sun et al. can be combined in such a way as to satisfy the limitations of claim 1. Note that, despite the change in its claim dependency, amended claim 10 proposes essentially the same subject matter as claimed in original claim 10. It was shown in the previous office action that the second set of rules for connecting control points, when evaluated within the context of the segmentation method derived from the combined teachings of Dickie, Geiger, Sethian, and Sun et al., is more accurate than first set of rules (in terms of the derived path), in the cases when the distance between the adjacent control points is sufficiently large (e.g. when $d > \tau_2$). The analysis presented there is still applicable to the present discussion, despite the difference in the definition of the first set of rules. Therefore, the teachings of Dickie, Geiger, Sethian, and Sun et al. can be combined to yield a segmentation method in accordance with claim 10.

29. *The following is in regard to Claim 12.* As shown above, the teachings of Dickie, Geiger, Sethian, and Sun et al. can be combined in such a way as to satisfy the limitations of claim 1. As shown in the previous Office Action, Geiger et al. teaches the step of receiving an object boundary estimate of a prior digital image frame and wherein the step of defining the restricted area, comprises defining the restricted area within the current digital image frame from the received object boundary estimate, including the received set of control points. For the sake of brevity, the

details presented in the previous Office Action relating to this step will be omitted here. See sections of the previous Office Action related to original claim 12. The teachings of Dickie, Geiger, Sethian, and Sun et al. can thus be combined to yield a segmentation method in accordance with claim 12.

30. *The following is in regard to Claims 13-15 and 18-19*. Note that the apparatuses set forth in claim 13, 14, 15, and 18-19 are essentially physical manifestations of the segmentation methods proposed in claims 1, 3, 6, and 9-10, respectively. Therefore, with regard to claims 13, 14, 15, and 9-10, arguments analogous to those presented above relating to the rejections of claim 1, 3, 6, and 9-10 are, respectively, applicable. See the discussion above relating to claims 1, 3, 6, and 9-10.

31. *The following is in regard to Claim 22.* As shown above, the teachings of Dickie, Geiger, Sethian, and Sun et al. can be combined to yield a segmentation apparatus in accordance with claim 13. As pointed out in the previous Office Action, it would have been obvious to one of ordinary skill in the art to perform all operations of the segmentation apparatus of claim 13 using a single processor. Clearly, by doing this one reduces the hardware complexity of the segmentation apparatus. In this way, the segmentation apparatus, obtained by the combination of Dickie, Gieger, Sethian, and Sun, can be trivially modified to satisfy the limitations of claim 22.

32. *The following is in regard to Claim 23.* As shown above, the teachings of Dickie, Geiger, Sethian, and Sun et al. can be combined to yield a segmentation apparatus in accordance with claim 13. Note that the apparatus of claim 23 is essentially a physical manifestation of the method of claim 5. Therefore, with regard to claim 23, arguments analogous to those presented above relating to claim 5 are applicable. See the discussion above relating to the rejections of claims 4 and 5.

33. *The following is in regard to Claim 24.* As shown above, the teachings of Dickie, Geiger, Sethian, and Sun et al. can be combined in such a way as to satisfy the limitations of claim 1. Sethian's Fast Marching Method (Sethian pp. 86-100) has been widely used in image segmentation applications. See, for example, Sethian Section 17.2.3 on pages 221-226. Segmentation is achieved by propagating a contour (an evolving front) – i.e. deriving a path – to conform to the boundary of an object of interest. See, for example, Fig. 17.7 on page 224 of Sethian. The Fast Marching Method (FMM) attempts to solve the front propagation problem by casting it in terms of solving the Eikonal equation:

$$\|\nabla T\| F = 1 \qquad (24.1)$$

See Sethian page 5. Since $\|\nabla T\| \geq \tilde{0}$, (24.1) implies that the speed $F > 0$, that is, the front propagates outward or forward always. See the discussion on page 4 (last paragraph) to page 5 of Sethian. Furthermore, when propagating the front, the FMM considers grid points (i.e. pixels, in the case of image data) within the boundary of a "narrow band of trial values " (Sethian Section 8.3 on page 90 and Fig. 8.4). In this way, the FMM can be regarded as a *forward* or *outward* marching approach to deriving the path between control points, wherein the path is constrained to a restricted area, namely the narrow band of trial values. Note that this narrow band is analogous to the narrow band of the Sethian's Narrow Band Level Set Method (see the discussion in the previous Office Action regarding original claim 1). The restricted area, as defined here, can thus be considered the same as the restricted area of claim 1. It would have been obvious to one of ordinary skill in the art, at the time of the applicant's claimed invention, to use the FMM as the first set of rules for deriving a path in the segmentation method, obtained by the aforementioned combination of Dickie, Geiger et al., Sethian, and Sun et al.'s teachings, as opposed to the first set of rules taught by Sun et al. The motivation to use the FMM in lieu of Sun et al.'s first set of rules would have been the fact that the FMM, as in the Level Set Method, naturally accommodates high-curvature regions and/or topological changes in the boundary of the object of interest (Sethian page 8, second bullet)[1]. Integrating, in this manner, the FMM into the segmentation method, obtained by combining the teachings of Dickie, Geiger et al., Sethian, and Sun et al. as discussed above, yields a method that conforms to limitations set forth in new claim 24.

34. *The following is in regard to Claim 25.* As shown above, the teachings of Dickie, Geiger, Sethian, and Sun et al. can be combined in such a way as to satisfy the limitations of claim 1. Sethian's Fast Marching Method (Sethian pp. 86-100) has been widely used in image segmentation. See, for example, Sethian Section 17.2.3 on pages 221-226. Segmentation is achieved by propagating a contour (an evolving front) – i.e. deriving a path – to conform to the boundary of an object of interest. See, for example, Fig. 17.7 on page 224 of Sethian. The Fast

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1 Active contour models, such as those utilized in the method of Sun et al. (Sun et al. Fig.2, step 52), are known to become unstable or fail in regions of high curvature or where the topology changes.

Marching Method (FMM) attempts to solve the front propagation problem by casting it in terms of solving the Eikonal equation:

$$\|\nabla T\| F = 1 \qquad (25.1)$$

35. See Sethian page 5. Since $\|\nabla T\| \geq 0$, (24.1) implies that the speed $F > 0$, that is, the front propagates outward or forward always. See the discussion on page 4 (last paragraph) to page 5 of Sethian. Furthermore, when propagating the front, the FMM considers grid points (i.e. pixels, in the case of image data) within the boundary of a "narrow band of trial values" (Sethian Section 8.3 on page 90 and Fig. 8.4). In this way, the FMM can be regarded as a *forward* or *outward* marching approach to deriving the path between control points, wherein the path is constrained to a restricted area, namely the narrow band of trial values. Note that this narrow band is analogous to the narrow band of the Sethian's Narrow Band Level Set Method (see the discussion in the previous Office Action regarding original claim 1). The restricted area, as defined here, can thus be considered the same as the restricted area of claim 1. It would have been obvious to one of ordinary skill in the art, at the time of the applicant's claimed invention, to use the FMM as the second set of rules for deriving a path in the segmentation method, obtained by the aforementioned combination of Dickie, Geiger et al., Sethian, and Sun et al.'s teachings, as opposed to the second set of rules taught by Sun et al. The motivation to use the FMM in lieu of Sun et al.'s second set of rules would have been the fact that the FMM, as in the Level Set Method, naturally accommodates high-curvature regions and/or topological changes in the boundary of the object of interest (Sethian page 8, second bullet)[2]. Integrating, in this manner, the FMM into the segmentation method, obtained by combining the teachings of Dickie, Geiger et al., Sethian, and Sun et al. as discussed above, yields a method that conforms to limitations set forth in new claim 25.

36. Claims 11 and 20-21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dickie, in view Geiger et al., Sethian, and Sun et al., in further view of Guo et al. ("New Video Object Segmentation Technique with Color/motion Information and Boundary Postprocessing").

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2 Active contour models, such as those utilized in the method of Sun et al. (Sun et al. Fig.2, step 52), are known to become unstable or fail in regions of high curvature or where the topology changes.

37. *The following is in regard to Claim 11.* As shown above, the teachings of Dickie, Geiger et al., Sethian, and Sun et al. can be combined in such a way as to satisfy the limitations of claim 1. However, neither of Dickie, Geiger et al., Sethian, and Sun et al. teach that the step of defining the restricted area comprises morphologically dilating a contour connecting the set of control points.

38. As shown in the previous Office Action, Guo et al. teach morphologically dilating the contour connecting the control points in order to obtain a restricted area about that contour. For the sake of brevity the details relating of this process and its compatibility with the methods of Dickie, Geiger et al., and Sethian are omitted here. See the discussion relating to the rejection of claim 11 in the previous Office Action. Since morphological dilation is performed on the derived contour, the addition of the aforementioned teachings of Sun et al., does not affect this compatibility. Therefore, it would have been obvious to one of ordinary skill in the art, at the time of the applicant's claimed invention, to morphologically dilate the derived contour in order to obtain a restricted area about the contour. Again, one is motivated to use morphological dilation of the derived contour, in the manner taught by Guo et al., in order to derive a restricted area about the contour, because the morphological dilation operation is a simple, efficient, and often-used region growing technique. The segmentation method thus obtained would conform to the limitations set forth in claim 11.

39. *The following is in regard to Claim 20.* Note that claim 20 recites substantially the same limitations as claim 11. Therefore, with regard to claim 20, arguments analogous to those presented above with respect to claim 11 are applicable.

40. *The following is in regard to Claim 21.* As just shown, the teachings of Dickie, Geiger et al., Sethian, Sun et al., and Guo et al. can be combined in such a way as to satisfy the limitations of claim 20. The following is an excerpt taken from Geiger, et al. (see Geiger, et al., the first to third paragraphs under Section III, "Tracking Deformable Contours" in the attached Errata):

> Suppose that we are given a sequence of images ... and a deformable contour associated with an object in the first frame. How can we use this information to automatically detect the subsequent contours?
> ...[T]he new contour should be close to the previous one... First, we simply copy the contour to the next frame and sample at the extrema points ... We consider these points to be the input, much like the ones provided by the user in the initial frame.

It should be clear from this excerpt that the contour of a previous image frame (e.g. the first image frame) serves as the object boundary estimate from a prior image frame, in accordance with the applicant's claim 12. Therefore, in tracking the contour representing the boundary of the object of interest, an object boundary estimate from a prior frame is received. Further note that, according to the excerpt above, a set of control points from the prior image frame (i.e. the points sampled from the previous contour) are also received. Geiger, et al. also show, in the above excerpt, that the object boundary estimate from a prior frame, itself, provides an initial estimate for the contour that represents the boundary of the object of interest with respect to the current frame. This, of course, facilitates the derivation of the minimal-cost closed contour that represents the boundary of the object of interest with respect to the current frame. Again, one of ordinary skill in the art could construct a narrow band about the received object boundary estimate, in the manner of Sethian's Narrow Band Level Set Method (see paragraph 7 above), thus, defining a restricted area in accordance with claim 12.. The motivation to do so is the same as that which was presented above for claim 1. Thus, given the teachings of Geiger, et al., as they are present here and the teachings of Sethian, as applied to claim 1, it would have been it would have been obvious to one of ordinary skill in the art, at the time of the applicant's claimed invention, to construct an image segmentation method, in accordance with claim 1, that receives an object boundary estimate from a prior frame and defines a narrow band restricted area about that boundary estimate. Arguments presented above with regard to claim 1 further support this conclusion. Thus, the teachings of Dickie, Geiger et al., Sethian, Sun et al., and Guo et al., when combined as discussed above, yield an apparatus, in accordance with claim 20, wherein said contour is an object boundary estimate from a prior digital frame that includes the initial set of control points.

Allowable Subject Matter

Objections, Allowable Subject Matter

41. Claim 26 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

42. The following is a statement of reasons for the indication of allowable subject matter.

Note that the subject matter claimed in claim 26 is the combination of the proposed methods of claim 24 and claim 25. It was shown above that, given the prior art available at the time of the applicant's claimed invention, claims 24 and 25 would have been obvious to one of ordinary skill in the art. In particular, it was shown above that the FMM could be reasonably considered as a *forward* or *outward* marching approach to deriving the path between control points, wherein the path is constrained to a restricted area, namely the narrow band of trial values. However, no prior art was encountered that suggested that the methods of claims 24 and 25 could be combined. Specifically, prior art was not found that showed independently, or could be reasonably combined to show, an apparatus, in accordance with claim 13, wherein the contour deriving means comprises a means for applying forward marching method approach to determine the path and a means for applying an outward marching approach to determine the path, such that the said path occurs entirely within the restricted area, and the said forward marching method applying means is active upon application of the first set of rules for deriving a path, and the said outward marching method applying means is active upon application of the second set of rules for deriving a path.

Conclusion

43. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

44. A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee

pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kevin Siangchin whose telephone number is (703)305-7569 The examiner can normally be reached on 9:00am - 5:30pm, Monday - Friday

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amelia Au can be reached on (703) 308-6604. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Kevin Siangchin
Examiner
Art Unit 2623
ks – 05/12/04

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SUPERVISORY PATENT EXAMINER
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